WHAT IS CLAIMED IS:

1. A vibration reduction control apparatus for an electric motor comprising:

a detecting means for detecting a motor rotational number of the electric motor and outputting a motor rotational number signal based on the motor rotational number;

a filter means for extracting a vibration signal of a predetermined frequency band from the motor rotational number signal; and

a feedback control means for performing a correcting process for the vibration signal.

2. A vibration reduction control apparatus for an electric motor comprising:

a detecting means for detecting a motor rotational number of the electric motor and outputting a motor rotational number signal based on the motor rotational number;

a control means for outputting a torque control signal based on the motor rotational number signal and controlling the electric motor;

a filter means for extracting a vibration signal of a predetermined frequency band including a frequency band of a disturbance vibration based on the motor rotational number signal detected by the detecting means;

a correcting means for performing a predetermined correcting process which reduces a vibration of the vibration signal for the vibration signal of the predetermined frequency band extracted by the filter means and obtaining a corrected amount; wherein

the control means performs an addition or a subtraction of the corrected amount obtained from the correcting means for the torque control signal of the electric motor.

3. A vibration reduction control apparatus according to claim 1, wherein

the predetermined frequency band includes at least a resonance frequency band of the electric motor or an assembled body with the electric motor.

4. A vibration reduction control apparatus according to claim 1, wherein

the electric motor is mounted on a vehicle body as a driving source of a vehicle.

5. A vibration reduction control apparatus according to claim 4, wherein

the predetermined frequency band includes at least the resonance frequency band of a vehicle body with which the electric motor is assembled.

6. A vibration reduction control apparatus according to claim 2, wherein

the correcting process by the correcting means includes a PD control calculation.

7. A design method of a vibration reduction control for a electric motor, the method comprising:

an identification experiment step of performing an identification experiment for the electric motor;

a model parameter identification step of calculating coefficients of a frequency transfer function based on an input signal and an output signal for the electric motor;

a reference model establishing step of establishing a reference model;

a correction coefficient calculating step of calculating a proportional gain and a differential gain of a controller so as to correspond with the reference model by using a model matching method; and

a judging step of judging whether an apparatus including a controller fulfills a predetermined performance condition or not; wherein

when the apparatus does not fulfill the performance condition, the proportional gain and the differential gain are repeatedly calculated by the correction coefficient calculating step until the apparatus fulfills the performance condition.

8. A design method of a vibration reduction control for an electric motor according to claim 7, the method further comprising:

a discrete step of performing a discrete processing when the apparatus satisfies the performance condition judged by the judging step.

9. A vibration reduction control apparatus for an electric motor comprising:

a detecting means for detecting a motor rotational number of the electric motor;

a control means for outputting a torque control signal based on the motor rotational number for the electric motor; and

a controller for suppressing effect by characteristic fluctuation of a control system based on the motor rotational number, and obtaining a corrected amount compensating sensibility characteristic when the characteristic fluctuation happens; wherein

the controller performs an addition or a subtraction of the corrected amount obtained from the controller for the torque control signal of the electric motor.

10. A vibration reduction control apparatus according to claim 9, wherein

the characteristic fluctuation of the control system includes at least one of difference in driving condition, electric motor type, assembled body assembled with the electric motor, torque ripple, sensor noise, and a steady component of the motor rotational number.

11. A vibration reduction control for an electric motor, the control comprising:

an express means for expressing by a generalized plant on H∞ control problem including characteristic fluctuation and sensibility characteristic of a control system for a transfer function of the controller;

a deal means for dealing a model error corresponding to the characteristic fluctuation and a virtual model error corresponding to a fluctuation of the sensibility characteristic as a structural fluctuation dependently; and

a derive means for adding a scaling matrix with scaling parameter corresponding to the each structural fluctuation to the generalized plant, and deriving the scaling matrix and the controller so as to minimize a H∞ norm of the generalized plant as a H∞ control problem with constant scaling matrix.

12. A design method of a vibration reduction control for an electric motor includes a controller for obtaining a corrected amount performing an addition or a subtraction for an instruction value on the torque control of the electric motor based on a motor rotational number, the method comprising:

setting a scale parameter d to a predetermined standard value; calculating the controller K(s) by γ-repeat method as H∞ control problem;

memorizing a H∞ norm of the generalized plant corresponding to a scaling parameter d at that time,

calculating the controller by gradually changing from the standard value for the scaling parameter d;

memorizing H∞ norm of the generalized plant corresponding to the scaling parameter d at that time,

calculating a local minimum value regarding H∞ norm of the generalized plant as a function f(d) for the scaling parameter d; establishing a scaling matrix D by a value of the scaling parameter d at that time;

calculating the controller K(s) by γ-repeat method using the value of the scaling parameter d giving local minimum value of function f(d);

and regarding the controller K(s) as an optimum solution, wherein

the optimum solution of the $H\infty$ control problem with constant scaling matrix is calculated according to each of the processing steps.

[formula 1]

$$
\begin{aligned}
z1 &= ws \cdot Rsys \cdot w1 - \frac{ws \cdot Psys}{1 + K \cdot Psys} w1 \\
&= ws \cdot \left(Rsys - \frac{Psys}{1 + K \cdot Psys} \right) w1
\end{aligned}
$$

[formula 2]

$$
\left\| ws \cdot \left(Rsys - \frac{Psys}{1 + K \cdot Psys} \right) \right\|_{\infty} < \gamma
$$

[formula 3]

$$
\|z1\| < \gamma \|w1\|
$$

[formula 4]

$$
\left\| \frac{Psys \cdot K \cdot wm1 \cdot wm2}{1 + Psys \cdot K} \right\|_{\infty} < 1
$$

[formula 5]

$$
\left\| \frac{K \cdot wn \cdot wm2}{1 + Psys \cdot K} \right\|_{\infty} < 1
$$

[formula 6]

$$\max_{\Delta 1 \Delta 2} \left\| ws \cdot \left(Rsys - \frac{Psys(1+\Delta 1)+\Delta 2}{1+K(Psys(1+\Delta 1)+\Delta 2)} \right) \right\|_{\infty} < \gamma$$

[formula 7]

$$|\Delta 1| < 1, \quad |\Delta 2| < 1, \quad |\Delta s| < 1$$

[formula 8]

$$D = diag(ds, d1, d2)$$

[formula 9]

$$\|D T_{zw} D^{-1}\|_{\infty} < 1$$

[formula 10]

$$D = diag(1, d, d)$$

[formula 11]

$$f(d) : \inf_{K} \|D T_{zw} D^{-1}\|_{\infty}$$

[formula 12]

$$U(k)=\sum_{i=1}^{n} a_i \cdot u(k-i)+\sum_{i=0}^{n} b_i \cdot Nm(k-i)$$

[formula 13]

$$ws(s)=1$$

$$wm1(s)=\frac{2(s+0.6213)}{(S+25.13)}$$

$$wn(s)=18$$

$$wm2(s)=\frac{6.25(s+25.13)^2(s+25.13)}{(s+314.2)(s+6283)^2}$$

[formula 14]

$$ws(s)=\frac{\begin{array}{l}0.14718(s+342.7)(s+23.59)\\(s+8.618)(s^2+1.253s+0.3926)\\(s^2-6.478s+11.49)(s^2+83.48s+3234)\\(s^2+708.8s+2.487e^5)\\(s^2+719.8s+2.621e^5)\end{array}}{\begin{array}{l}(s+120.7)(s+25.13)(s+0.6351)\\(s^2+8.587s+24.92)(s^2+22.75s+50.22)\\(s^2+118.1s+1.22e^4)\\(s^2+708.8s+2.487e^5)\\(s^2+719.8s+2.621e^5)\end{array}}$$

[formula 15]

$$D=diag(1,1.788,1.1788)$$